

Learning from routinely produced clinical data and Big Data technology in Radiation Oncology

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Valorisation Addendum

Providing the best quality care while keeping it affordable is one of the biggest challenges of the 21st century. Finding solutions to start overcoming this challenge will require data. The work presented in this thesis contributes to the implementation of data driven medicine to help care providers use this technology.

The projects funded by Eurostars have a strong focus on commercialization of the research. Project groups consist of academic and one or more commercial parties. During the Semantic DICOM project (Chapter 3) a new kind of picture archive application was developed. The main focus of this software is to easily find medical images and link derived data from these images directly to the source. SOHARD software GmbH (Fürth, Germany) was the commercial party involved in the project and is selling the software created in this project, mainly for research purposes. The image analysis application was also shared with the community through an Open Source project on bitbucket (<https://bitbucket.org/account/user/maastro/projects/MIA>). The application can process radiotherapy DICOM objects to calculate dose volume histograms. With these software products medical images and their derived features can be made FAIR to improve the data management of research projects. The second project, CloudAtlas, involved both Mirada Medical Ltd (Oxford, UK) and SOHARD software. The original project plan was to provide a cloud platform to perform atlas contouring. The idea was too ambitious to realize in the two years of the project, so the team focused on the work necessary to eventually provide this solution. The project resulted into two commercial products. Mirada Medical developed a new automatic contouring method using Deep Learning technology which can be used to improve delineation efficiency in clinical practice - they have received FDA clearance for this product in July 2018. SOHARD software created a radiotherapy DICOM web-viewer, which was currently unavailable as a commercial product but is expected to be a valuable tool for researchers.

Medical Data Works B.V.

Medical Data Works is a start-up which was started in 2017 as a result of the various research projects of the MAASTRO Clinic knowledge engineering team. Medical Data Works provides consultancy to help start or improve data collec-



tion, integration or analysis projects. Sharing insights learned and supporting the software created by the knowledge engineering team with care providers is our main focus. Our current domain is radiation oncology, but the technology could be applied to medical oncology and even other medical specialties. Medical Data Works closed its first financial year with a profit.

The FAIR platform described in **Chapter 8** is scheduled to be developed by Medical Data Works in 2019. To support the consulting activities of the company the platform will be developed with production grade software development requirements to ensure it can be adopted by hospital IT-departments. The software which is installed on network infrastructure of the hospital, even if it is for research purposes, needs to be supported. The IT-department needs to have Service Level Agreements (SLAs) with a third-party. This is often a roadblock for software written for research purposes, it is not in the interest of the researcher to support their software once the work is published. Medical Data Works wants to adapt Open Source software from successful research projects and provide support through SLAs to help researchers overcome this roadblock and improve utilization of research software.

The biggest concern is scalability. The software in its current state is highly dependent on specialists (data scientists) for configuration and utilization. Medical Data Works can provide this service by creating a larger team of data scientists. However, the technical people required for the job are in short supply in the Netherlands, even worldwide. When the company is involved in enough projects, scaling the available personnel will be challenging. The other challenge is the cost of the consultancy and support. Setting up a FAIR-data platform requires a data scientist to analyze the data and create the transformations. This is time consuming and heavily dependent on the source data systems, any change in the source will have to be incorporated in the data capture and transformation part of the FAIR-data platform. The goal is to simplify the process with smart software solutions to enable a team of service engineers to perform these tasks.